



## TFT LCD Approval Specification

# MODEL NO.: M215H3-LA1

Customer : Common Model

Approved by : \_\_\_\_\_

Note :

| 核准時間                   | 部門           | 審核                                  | 角色       | 投票     |
|------------------------|--------------|-------------------------------------|----------|--------|
| 2010-05-28<br>11:05:35 | MTR<br>產品管理處 | <div>吳<br/>2010.05.28<br/>柏 勳</div> | Director | Accept |

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## Approval

## REVISION HISTORY

| Version | Date       | Section | Description                                  |
|---------|------------|---------|----------------------------------------------|
| Ver 3.0 | Mar,17,'10 | All     | M215H3-LA1 Specifications was first issued ° |
| Ver 3.1 | May,21,'10 | 12      | Update 2D drawing                            |



## 1. GENERAL DESCRIPTION

### 1.1 OVERVIEW

The M215H3-LA1 model is a 21.5 inch wide TFT-LCD module with LED Backlight Unit and a 30-pin 2ch-LVDS interface. This module supports 1920 x 1080 Full HD (16:9 wide screen) mode and displays up to 16.7 millions colors. The converter module for the Backlight Unit is not built in.

### 1.2 FEATURES

- Super wide viewing angle
- High contrast ratio
- Fast response time
- Low power consumption
- FULL HD(1920 x 1080 pixels) resolution
- DE (Data Enable) only mode
- LVDS (Low Voltage Differential Signaling) interface
- Lower power consumption
- RoHS compliance.

### 1.3 APPLICATION

- Workstation & desktop monitor
- Display terminals for AV application

### 1.4 GENERAL SPECIFICATIONS

| Item                     | Specification                    | Unit  | Note |
|--------------------------|----------------------------------|-------|------|
| Diagonal size            | 546.86 (21.53")                  | mm    | (1)  |
| Active Area              | 476.64 x 268.11                  | mm    |      |
| Bezel Opening Area       | 479.8 (H) x 271.3 (V)            | mm    |      |
| Driver Element           | a-Si TFT active matrix           | -     | -    |
| Pixel Number             | 1920 x R.G.B. x 1080             | pixel | -    |
| Pixel Pitch              | 0.248(H) x 0.248(V)              | mm    | -    |
| Pixel Arrangement        | RGB vertical stripe              | -     | -    |
| Display Colors           | 16.7 millions                    | color | -    |
| Transmissive Mode        | Normally White                   | -     | -    |
| Surface Treatment        | Hard coating (3H), AG (Haze 25%) | -     | -    |
| Module Power Consumption | 15.28                            | Watt  | (2)  |

### 1.5 MECHANICAL SPECIFICATIONS

| Item                            |               | Min.                                                                                                | Typ.  | Max.  | Unit | Note |
|---------------------------------|---------------|-----------------------------------------------------------------------------------------------------|-------|-------|------|------|
| Module Size                     | Horizontal(H) | 495.1                                                                                               | 495.6 | 496.1 | mm   | (1)  |
|                                 | Vertical(V)   | 291.7                                                                                               | 292.2 | 292.7 | mm   |      |
|                                 | Depth(D)      | 11.0                                                                                                | 11.5  | 12.0  | mm   |      |
| Weight                          |               | --                                                                                                  | 2010  | 2060  | g    |      |
| I/F connector mounting position |               | The mounting inclination of the connector makes the screen center within ±0.5 mm as the horizontal. |       |       |      |      |

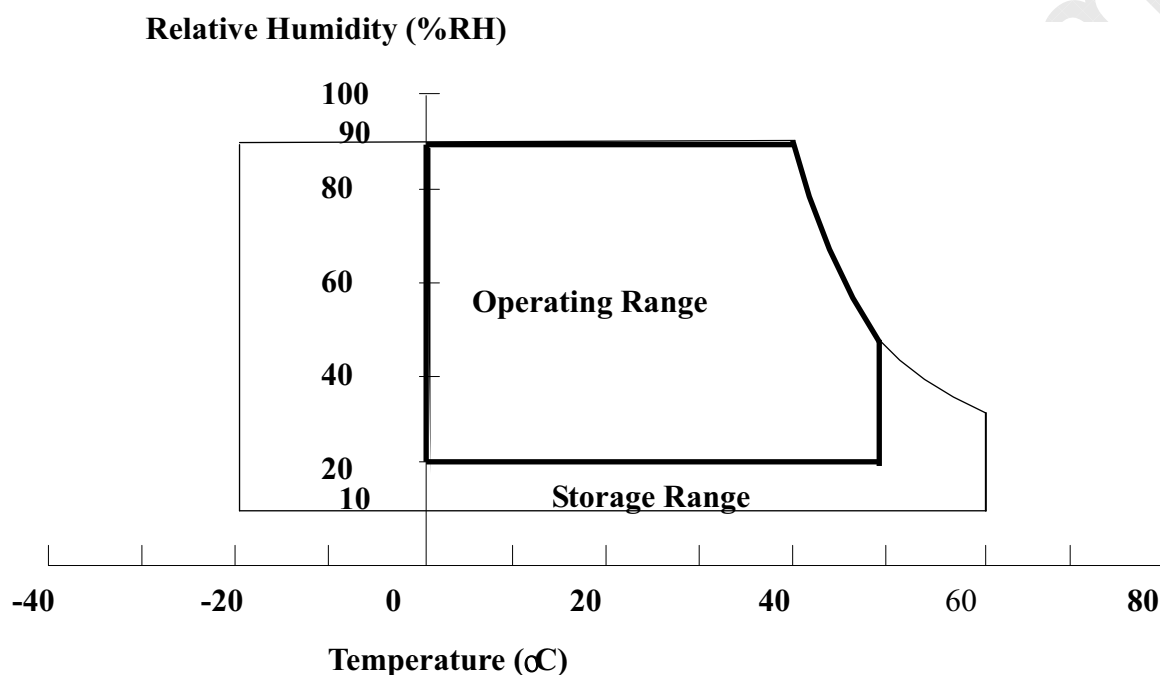
Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

Note (2) Please refer to sec. 3.1 & 3.2 in this document for more information of power consumption

## 2. ABSOLUTE MAXIMUM RATINGS

### 2.1 ABSOLUTE RATINGS OF ENVIRONMENT

| Item                          | Symbol            | Value  |      | Unit | Note       |
|-------------------------------|-------------------|--------|------|------|------------|
|                               |                   | Min.   | Max. |      |            |
| Storage Temperature           | T <sub>ST</sub>   | -20    | +60  | °C   | (1)        |
| Operating Ambient Temperature | T <sub>OP</sub>   | 0      | +50  | °C   | (1), (2)   |
| Shock (Non-Operating)         | S <sub>NOP</sub>  | -      | 50   | G    | (3), (5)   |
| Vibration (Non-Operating)     | V <sub>NOP</sub>  | -      | 1.5  | G    | (4), (5)   |
| LCD Cell Life Time            | L <sub>CELL</sub> | 50,000 | -    | Hrs  | MTBF based |



Note (1) Temperature and relative humidity range is shown in the figure below.

(a) 90% RH Max. ( $T_a \leq 40^\circ\text{C}$ ).

(b) Wet-bulb temperature should be  $39^\circ\text{C}$  Max. ( $T_a > 40^\circ\text{C}$ ).

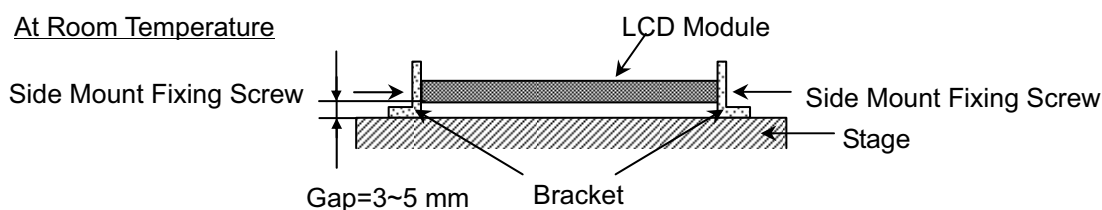
(c) No condensation.

Note (2) The temperature of panel surface should be  $0^\circ\text{C}$  Min. and  $60^\circ\text{C}$  Max.

Note (3) 50G, 11 ms, half-sine wave, 1 time for  $\pm X$ ,  $\pm Y$ ,  $\pm Z$ .

Note (4) 10 ~ 300 Hz, sweep rate 10 min / cycle, 30 min for X,Y,Z axis

Note (5) Upon the Vibration and Shock tests, the fixture used to hold the module must be firm and rigid enough to prevent the module from twisting or bending by the fixture.





## 2.2 ELECTRICAL ABSOLUTE RATINGS

### 2.2.1 TFT LCD MODULE

| Item                 | Symbol          | Value |      | Unit | Note |
|----------------------|-----------------|-------|------|------|------|
|                      |                 | Min.  | Max. |      |      |
| Power Supply Voltage | V <sub>CC</sub> | -0.3  | +6   | V    | (1)  |

### 2.2.2 BACK LIGHT UNIT

| Item                              | Symbol         | Value |      |      | Unit | Note                  |
|-----------------------------------|----------------|-------|------|------|------|-----------------------|
|                                   |                | Min.  | Typ. | Max. |      |                       |
| LED Forward Current Per Input Pin | I <sub>F</sub> | 0     | 40   | 50   | mA   | (1), (2)<br>Duty=100% |
| LED Reverse Voltage Per Input Pin | V <sub>R</sub> | ---   | ---  | 65   | V    |                       |

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for input pin of LED light bar at Ta=25±2 °C (Refer to 3.2 and 3.3 for further Information).

### 3. ELECTRICAL CHARACTERISTICS

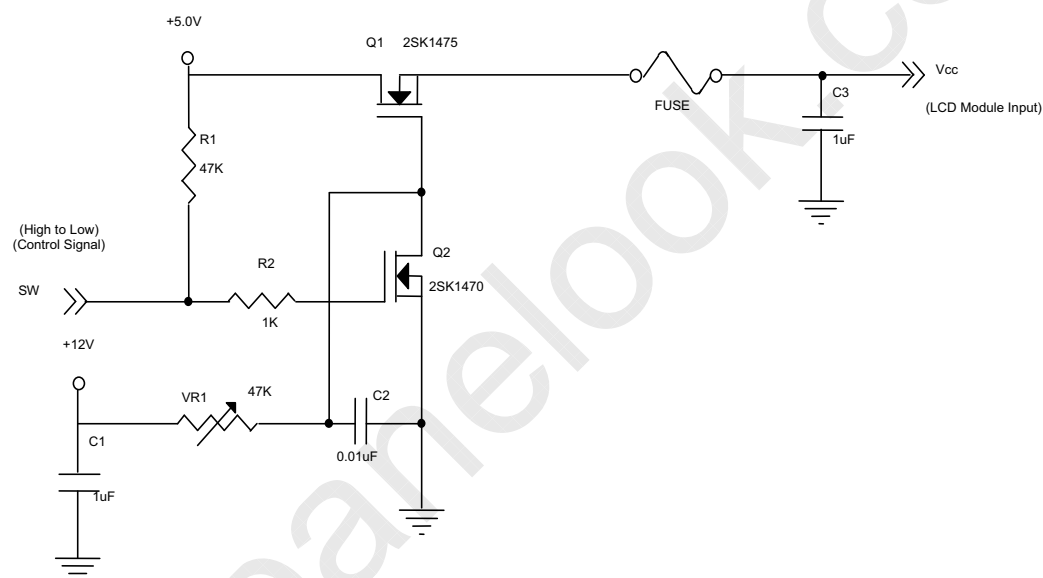
#### 3.1 TFT LCD MODULE

 $T_a = 25 \pm 2^\circ\text{C}$ 

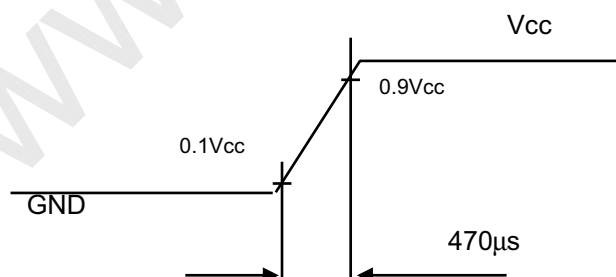
| Parameter                                 |                 | Symbol            | Value |      |      | Unit | Note |
|-------------------------------------------|-----------------|-------------------|-------|------|------|------|------|
|                                           |                 |                   | Min.  | Typ. | Max. |      |      |
| Power Supply Voltage                      |                 | V <sub>CC</sub>   | 4.5   | 5.0  | 5.5  | V    | -    |
| Ripple Voltage                            |                 | V <sub>RP</sub>   | -     | --   | 300  | mV   | Vp-p |
| Power on Rush Current                     |                 | I <sub>RUSH</sub> | -     | --   | 3    | A    | (2)  |
| Power Supply Current                      | White           | I <sub>CC</sub>   | -     | 0.51 | 0.61 | A    | (3)a |
|                                           | Black           |                   | -     | 1.05 | 1.26 | A    | (3)b |
|                                           | Vertical Stripe |                   | -     | 1.06 | 1.26 | A    | (3)c |
| Power consumption(without Backlight Unit) |                 | Pl <sub>cd</sub>  | -     | 5.3  | 6.3  | W    | (4)  |
| LVDS differential input voltage           |                 | V <sub>id</sub>   | 200   | -    | 600  | mV   |      |
| LVDS common input voltage                 |                 | V <sub>ic</sub>   | 1     | 1.2  | 1.4  | V    |      |

Note (1) The module should be always operated within above ranges.

Note (2) Power on rush current measurement conditions:



**V<sub>CC</sub> rising time is 470μs**



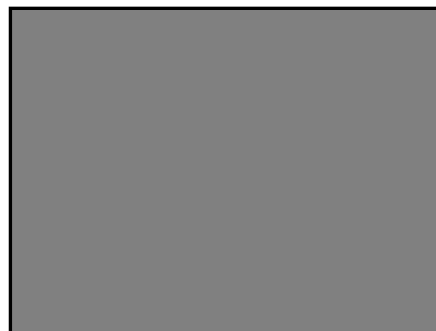
Note (3) The specified power supply current is under the conditions at  $V_{CC} = 5.0\text{ V}$ ,  $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$ ,  $f_v = 60\text{ Hz}$ , whereas a power dissipation check pattern below is displayed.

a. White Pattern



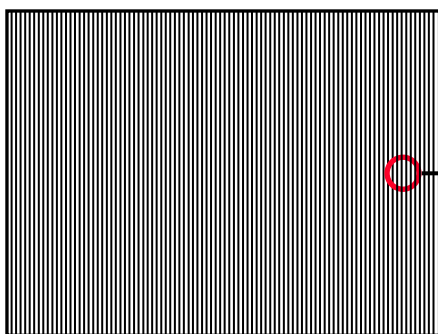
Active Area

b. Black Pattern

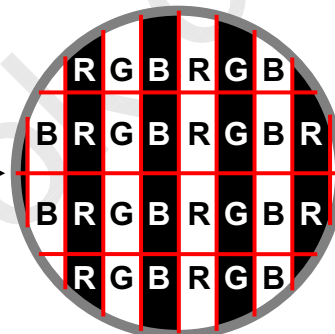


Active Area

c. Vertical Stripe Pattern



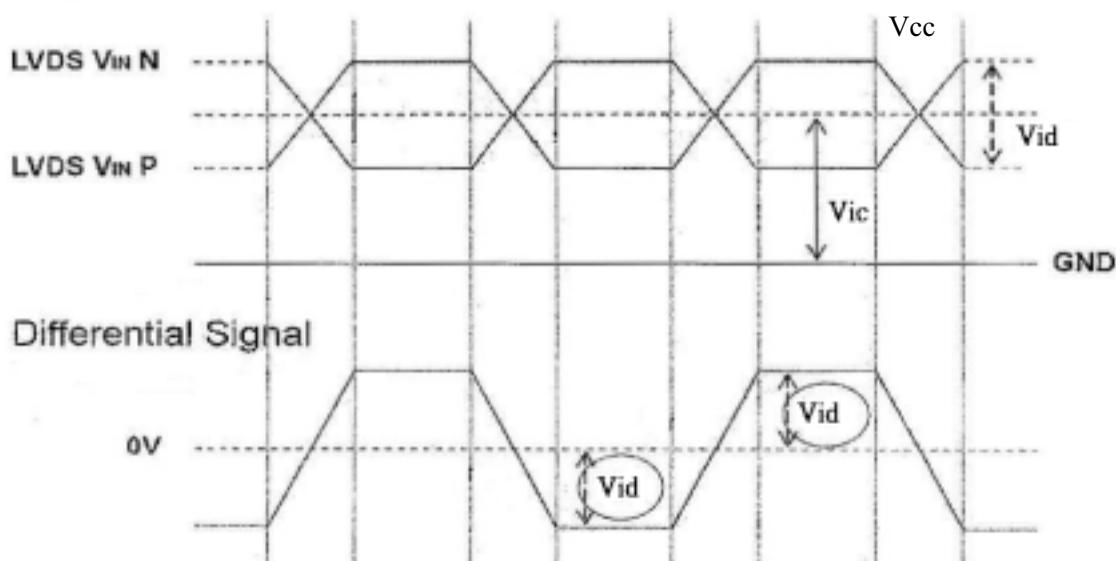
Active Area



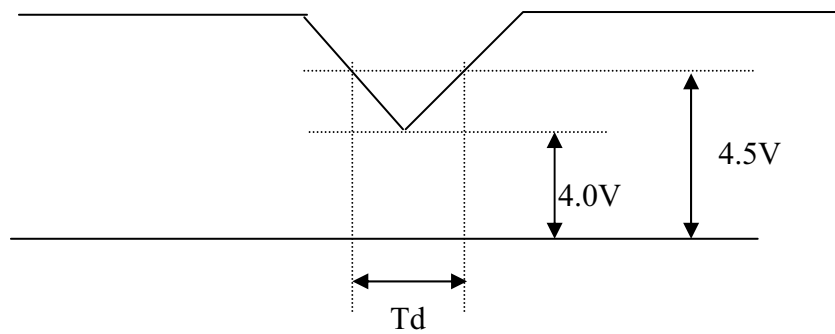
Note (4) The power consumption is specified at the pattern with the maximum current

Note (5) VID waveform condition

### Single-End





**3.2 Vcc Power Dip Condition:**

Dip condition:  $4.0V \leq V_{cc} \leq 4.5V, T_d \leq 20ms$

## 3.3 BACKLIGHT UNIT

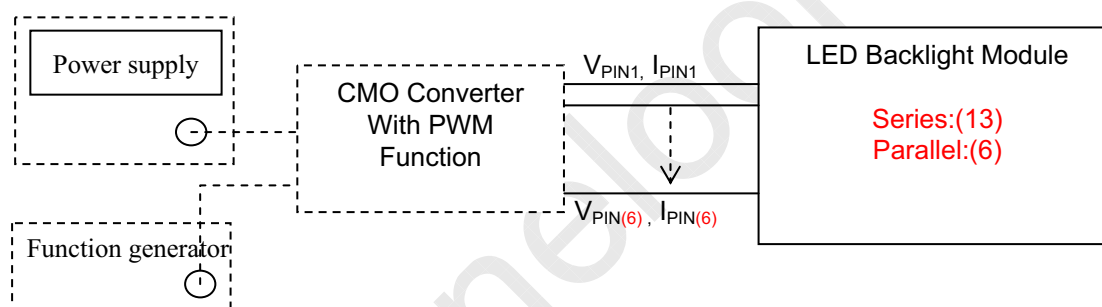
Ta = 25 ± 2 °C

| Parameter                                 | Symbol           | Value |       |       | Unit | Note                                              |
|-------------------------------------------|------------------|-------|-------|-------|------|---------------------------------------------------|
|                                           |                  | Min.  | Typ.  | Max.  |      |                                                   |
| LED Light Bar Input Voltage Per Input Pin | V <sub>PIN</sub> | ---   | 41.6  | 45.5  | V    | (1),<br>Duty=100%,<br><b>I<sub>PIN</sub>=40mA</b> |
| LED Light Bar Current Per Input Pin       | I <sub>PIN</sub> | 0     | 40    | 50    | mA   | (1), (2)<br>Duty=100%                             |
| LED Life Time                             | L <sub>LED</sub> | 30000 | ---   | ---   | Hrs  | (3)                                               |
| Power Consumption                         | P <sub>BL</sub>  | ---   | 9.984 | 10.92 | W    | (1)<br>Duty=100%,<br><b>I<sub>PIN</sub>=40mA</b>  |

Note (1) LED light bar input voltage and current are measured by utilizing a true RMS multimeter as shown below:

Note (2)  $P_{BL} = I_{PIN} \times V_{PIN} \times (6)$  input pins, LED light bar circuit is (13)Series, (6)Parallel.

Note (3) The lifetime of LED is defined as the time when LED packages continue to operate under the conditions at Ta = 25 ± 2 °C and I = (20)mA (per chip) until the brightness becomes ≤ 50% of its original value.



### 3.4 LIGHTBAR Connector Pin Assignment

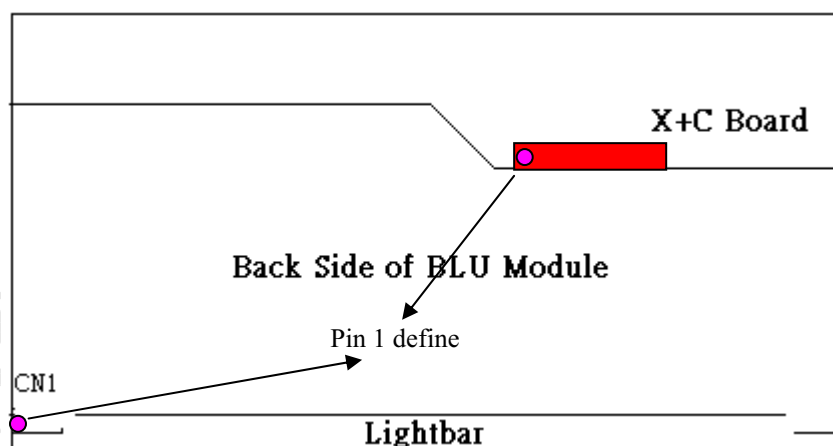
Connector: B-F,7083K-F12N-00L ,ENTERY(恩得利)

161035-12041-3 P-TWO (禾昌), GB5DH120-112M-7H,Foxconn(鴻海)

Input Connector pin assignment:

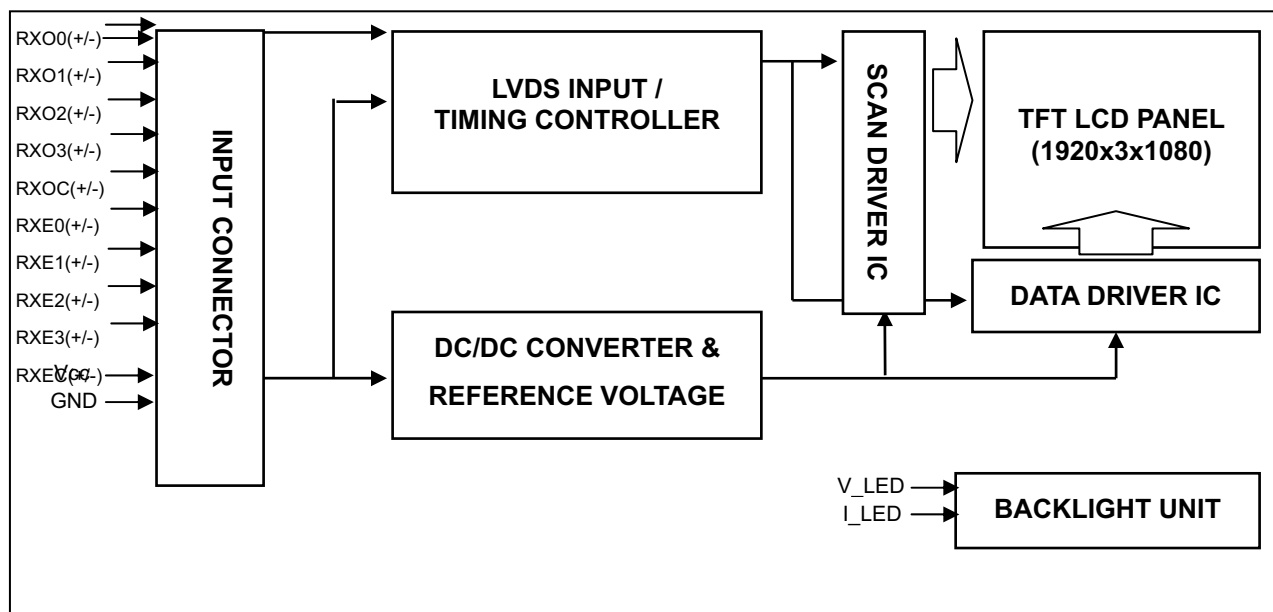
(1) Input connector pin assignment: CN1

| Input connector CN1 |                              | Comments                                 |
|---------------------|------------------------------|------------------------------------------|
| (vendor)<br>ENTERY  | (type)<br>B-F,7083K-F12N-00L |                                          |
| Pin                 | Function                     |                                          |
| 1                   | NC                           | No connect                               |
| 2                   | LED1                         | LED1 negative polarity                   |
| 3                   | LED2                         | LED2 negative polarity                   |
| 4                   | LED3                         | LED3 negative polarity                   |
| 5                   | NC                           | No connect                               |
| 6                   | VLED (41.6V)                 | Input voltage Power Supply + (41.6V.typ) |
| 7                   | VLED (41.6V)                 | Input voltage Power Supply + (41.6V.typ) |
| 8                   | NC                           | No connect                               |
| 9                   | LED4                         | LED4 negative polarity                   |
| 10                  | LED5                         | LED5 negative polarity                   |
| 11                  | LED6                         | LED6 negative polarity                   |
| 12                  | NC                           | No connect                               |



## 4. BLOCK DIAGRAM

### 4.1 TFT LCD MODULE





## 5. INPUT TERMINAL PIN ASSIGNMENT

### 5.1 TFT LCD MODULE

| Pin | Name  | Description                                              |
|-----|-------|----------------------------------------------------------|
| 1   | RXO0- | Negative LVDS differential data input. Channel O0 (odd)  |
| 2   | RXO0+ | Positive LVDS differential data input. Channel O0 (odd)  |
| 3   | RXO1- | Negative LVDS differential data input. Channel O1 (odd)  |
| 4   | RXO1+ | Positive LVDS differential data input. Channel O1 (odd)  |
| 5   | RXO2- | Negative LVDS differential data input. Channel O2 (odd)  |
| 6   | RXO2+ | Positive LVDS differential data input. Channel O2 (odd)  |
| 7   | GND   | Ground                                                   |
| 8   | RXOC- | Negative LVDS differential clock input. (odd)            |
| 9   | RXOC+ | Positive LVDS differential clock input. (odd)            |
| 10  | RXO3- | Negative LVDS differential data input. Channel O3(odd)   |
| 11  | RXO3+ | Positive LVDS differential data input. Channel O3 (odd)  |
| 12  | RXE0- | Negative LVDS differential data input. Channel E0 (even) |
| 13  | RXE0+ | Positive LVDS differential data input. Channel E0 (even) |
| 14  | GND   | Ground                                                   |
| 15  | RXE1- | Negative LVDS differential data input. Channel E1 (even) |
| 16  | RXE1+ | Positive LVDS differential data input. Channel E1 (even) |
| 17  | GND   | Ground                                                   |
| 18  | RXE2- | Negative LVDS differential data input. Channel E2 (even) |
| 19  | RXE2+ | Positive LVDS differential data input. Channel E2 (even) |
| 20  | RXEC- | Negative LVDS differential clock input. (even)           |
| 21  | RXEC+ | Positive LVDS differential clock input. (even)           |
| 22  | RXE3- | Negative LVDS differential data input. Channel E3 (even) |
| 23  | RXE3+ | Positive LVDS differential data input. Channel E3 (even) |
| 24  | GND   | Ground                                                   |
| 25  | NC    | Not connection, this pin should be open.                 |
| 26  | NC    | Not connection, this pin should be open.                 |
| 27  | NC    | Not connection, this pin should be open.                 |
| 28  | VCC   | +5.0V power supply                                       |
| 29  | VCC   | +5.0V power supply                                       |
| 30  | VCC   | +5.0V power supply                                       |

Note (1) Connector Part No.: 093G30-B2001A-M4(STARCONN) or MSCKT2407P30H,STM(信盛)

Note (2) Mating Wire Cable Connector Part No.: FI-X30H(JAE) or FI-X30HL(JAE)

Note (3) Mating FFC Cable Connector Part No.: B-F,7083K-F12N-00L ,ENTERY(恩得利)

Note (4) The first pixel is odd.

Note (5) Input signal of even and odd clock should be the same timing.

**Approval**

## 5.2 LVDS DATA MAPPING TABLE

|                 |             |     |     |     |     |     |     |     |
|-----------------|-------------|-----|-----|-----|-----|-----|-----|-----|
| LVDS Channel O0 | LVDS output | D7  | D6  | D4  | D3  | D2  | D1  | D0  |
|                 | Data order  | OG0 | OR5 | OR4 | OR3 | OR2 | OR1 | OR0 |
| LVDS Channel O1 | LVDS output | D18 | D15 | D14 | D13 | D12 | D9  | D8  |
|                 | Data order  | OB1 | OB0 | OG5 | OG4 | OG3 | OG2 | OG1 |
| LVDS Channel O2 | LVDS output | D26 | D25 | D24 | D22 | D21 | D20 | D19 |
|                 | Data order  | DE  | NA  | NA  | OB5 | OB4 | OB3 | OB2 |
| LVDS Channel O3 | LVDS output | D23 | D17 | D16 | D11 | D10 | D5  | D27 |
|                 | Data order  | NA  | OB7 | OB6 | OG7 | OG6 | OR7 | OR6 |
| LVDS Channel E0 | LVDS output | D7  | D6  | D4  | D3  | D2  | D1  | D0  |
|                 | Data order  | EG0 | ER5 | ER4 | ER3 | ER2 | ER1 | ER0 |
| LVDS Channel E1 | LVDS output | D18 | D15 | D14 | D13 | D12 | D9  | D8  |
|                 | Data order  | EB1 | EB0 | EG5 | EG4 | EG3 | EG2 | EG1 |
| LVDS Channel E2 | LVDS output | D26 | D25 | D24 | D22 | D21 | D20 | D19 |
|                 | Data order  | DE  | NA  | NA  | EB5 | EB4 | EB3 | EB2 |
| LVDS Channel E3 | LVDS output | D23 | D17 | D16 | D11 | D10 | D5  | D27 |
|                 | Data order  | NA  | EB7 | EB6 | EG7 | EG6 | ER7 | ER6 |



### 5.3 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color versus data input.

| Color               |                 | Data Signal |    |    |    |    |    |    |    |       |    |    |    |    |    |    |    |      |    |    |    |    |    |    |    |
|---------------------|-----------------|-------------|----|----|----|----|----|----|----|-------|----|----|----|----|----|----|----|------|----|----|----|----|----|----|----|
|                     |                 | Red         |    |    |    |    |    |    |    | Green |    |    |    |    |    |    |    | Blue |    |    |    |    |    |    |    |
|                     |                 | R7          | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7    | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7   | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Colors        | Black           | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Red             | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Green           | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Blue            | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
|                     | Cyan            | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
|                     | Magenta         | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
|                     | Yellow          | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | White           | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
| Gray Scale Of Red   | Red(0) / Dark   | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Red(1)          | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Red(2)          | 0           | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | :               | :           | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | :  |
|                     | :               | :           | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | :  |
|                     | Red(253)        | 1           | 1  | 1  | 1  | 1  | 1  | 0  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Red(254)        | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Red(255)        | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Gray Scale Of Green | Green(0) / Dark | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Green(1)        | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Green(2)        | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | :               | :           | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | :  |
|                     | :               | :           | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | :  |
|                     | Green(253)      | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 0  | 1  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Green(254)      | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Green(255)      | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Gray Scale Of Blue  | Blue(0) / Dark  | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Blue(1)         | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 1  |
|                     | Blue(2)         | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 1  | 0  |
|                     | :               | :           | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | :  |
|                     | :               | :           | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | :  |
|                     | Blue(253)       | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1  | 1  | 0  | 1  |
|                     | Blue(254)       | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 0  |
|                     | Blue(255)       | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  |

Note (1) 0: Low Level Voltage, 1: High Level Voltage

## 6. INTERFACE TIMING

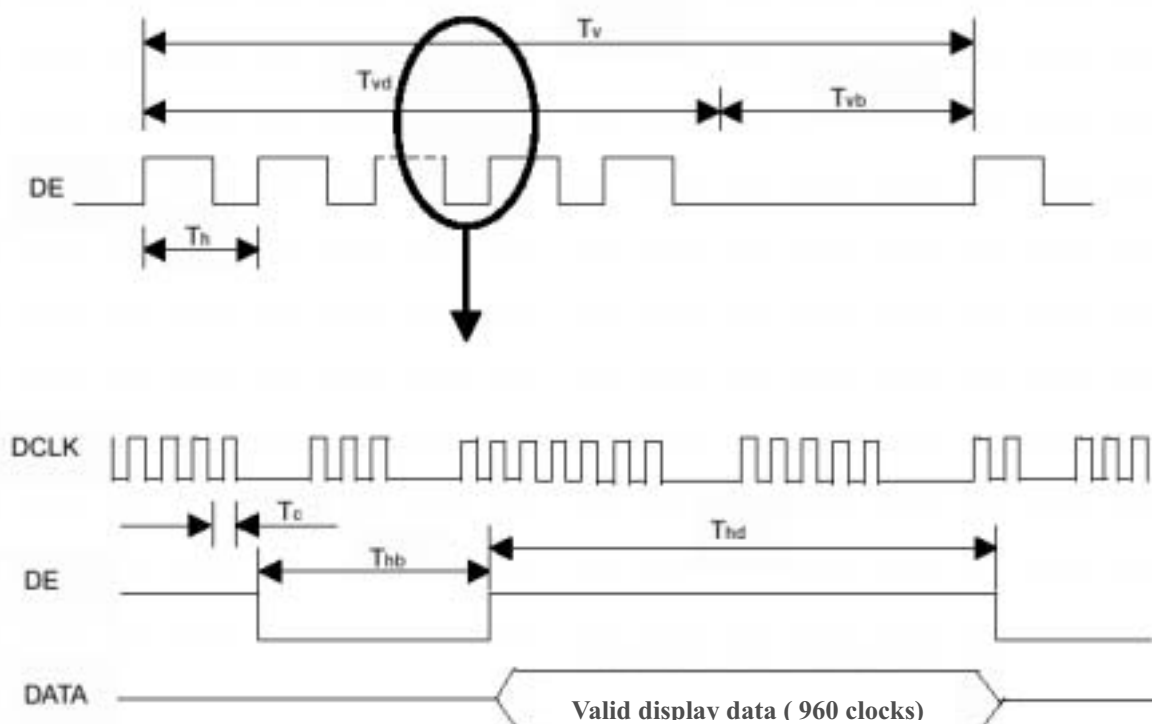
### 6.1 INPUT SIGNAL TIMING SPECIFICATIONS

The input signal timing specifications are shown as the following table and timing diagram.

| Signal                         | Item                                 | Symbol                  | Min.                            | Typ.  | Max.                            | Unit           | Note                                             |
|--------------------------------|--------------------------------------|-------------------------|---------------------------------|-------|---------------------------------|----------------|--------------------------------------------------|
| LVDS Clock                     | Frequency                            | F <sub>c</sub>          | 58.54                           | 74.25 | 97.98                           | MHz            | -                                                |
|                                | Period                               | T <sub>c</sub>          | -                               | 13.47 | -                               | ns             | -                                                |
|                                | Input cycle to cycle jitter          | T <sub>rcl</sub>        | —                               | —     | 200                             | ps             | (1)                                              |
|                                | Spread spectrum modulation range     | F <sub>clk_in_mod</sub> | F <sub>c</sub> *98%             |       | F <sub>c</sub> *102%            | MHz            | (2)                                              |
|                                | Spread spectrum modulation frequency | F <sub>SSM</sub>        |                                 |       | 200                             | KHz            |                                                  |
|                                | High Time                            | T <sub>ch</sub>         | -                               | 4/7   | -                               | T <sub>c</sub> | -                                                |
|                                | Low Time                             | T <sub>cl</sub>         | -                               | 3/7   | -                               | T <sub>c</sub> | -                                                |
| LVDS Data                      | Setup Time                           | T <sub>lvs</sub>        | 600                             | -     | -                               | ps             | (3)                                              |
|                                | Hold Time                            | T <sub>lvh</sub>        | 600                             | -     | -                               | ps             |                                                  |
| Vertical Active Display Term   | Frame Rate                           | Fr                      | 50                              | 60    | 75                              | Hz             | T <sub>v</sub> =T <sub>vd</sub> +T <sub>vb</sub> |
|                                | Total                                | T <sub>v</sub>          | 1115                            | 1125  | 1136                            | Th             | -                                                |
|                                | Display                              | T <sub>vd</sub>         | 1080                            | 1080  | 1080                            | Th             | -                                                |
|                                | Blank                                | T <sub>vb</sub>         | T <sub>v</sub> -T <sub>vd</sub> | 45    | T <sub>v</sub> -T <sub>vd</sub> | Th             | -                                                |
| Horizontal Active Display Term | Total                                | T <sub>h</sub>          | 1050                            | 1100  | 1150                            | T <sub>c</sub> | T <sub>h</sub> =T <sub>hd</sub> +T <sub>hb</sub> |
|                                | Display                              | T <sub>hd</sub>         | 960                             | 960   | 960                             | T <sub>c</sub> | -                                                |
|                                | Blank                                | T <sub>hb</sub>         | T <sub>h</sub> -T <sub>hd</sub> | 140   | T <sub>h</sub> -T <sub>hd</sub> | T <sub>c</sub> | -                                                |

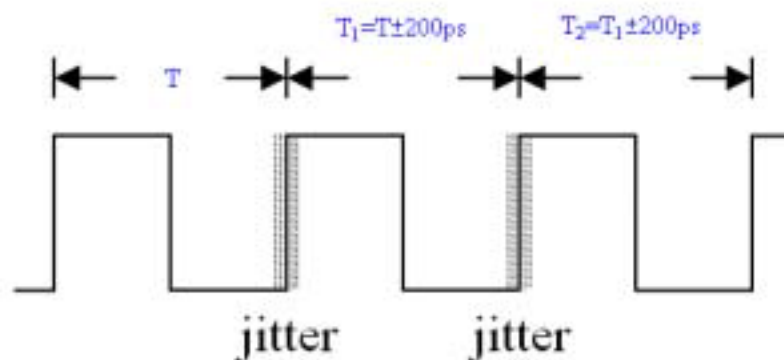
Note : Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

#### INPUT SIGNAL TIMING DIAGRAM

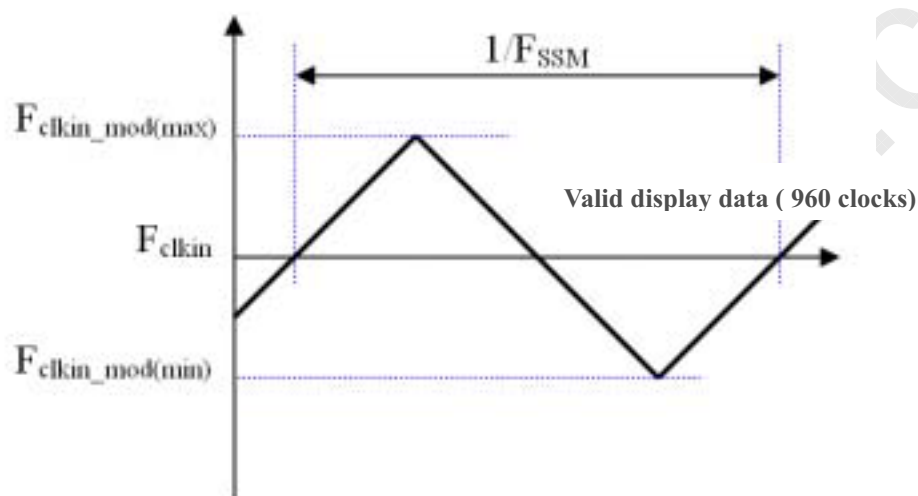




Note (1) The input clock cycle-to-cycle jitter is defined as below figures.  $Trcl = |T_1 - T_1|$

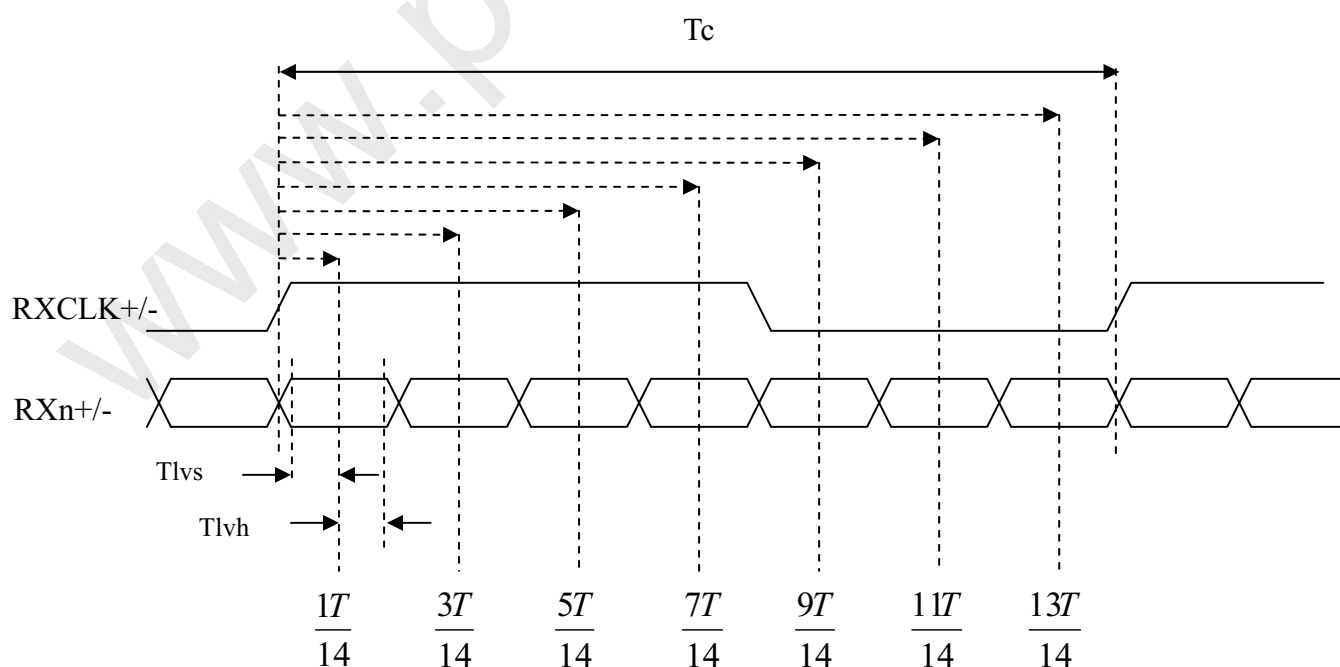


Note (2) The SSCG (Spread spectrum clock generator) is defined as below figures.



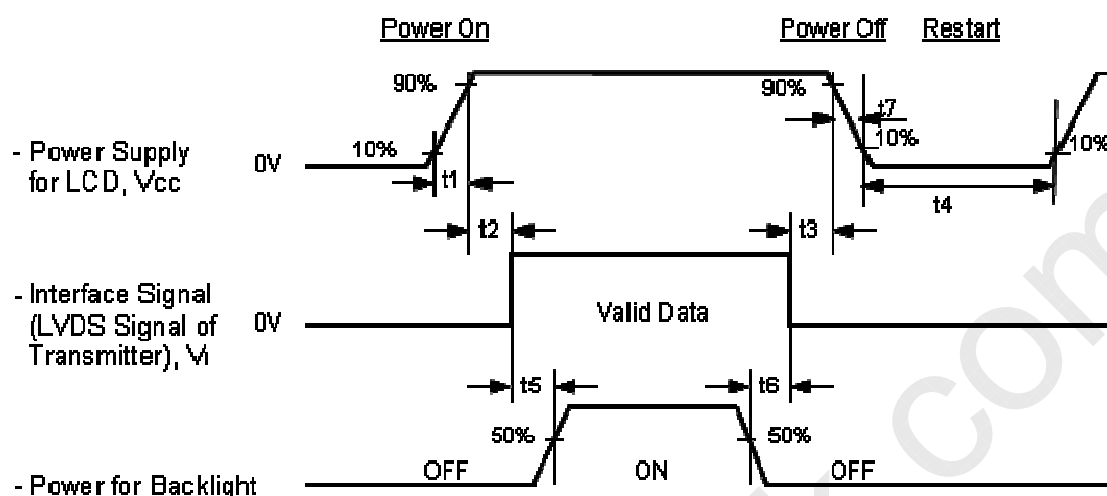
Note (3) The LVDS timing diagram and setup/hold time is defined and showing as the following figures.

### LVDS RECEIVER INTERFACE TIMING DIAGRAM



## 6.2 POWER ON/OFF SEQUENCE

To prevent a latch-up or DC operation of LCD module, the power on/off sequence should be as the diagram below.



### Timing Specifications:

- $0.5 < t1 \leq 10 \text{ msec}$
- $0 < t2 \leq 50 \text{ msec}$
- $0 < t3 \leq 50 \text{ msec}$
- $t4 \geq 500 \text{ msec}$
- $t5 \geq 450 \text{ msec}$
- $t6 \geq 90 \text{ msec}$
- $5 \leq t7 \leq 100 \text{ msec}$

### Note.

- (1) The supply voltage of the external system for the module input should be the same as the definition of Vcc.
- (2) When the backlight turns on before the LCD operation of the LCD turns off, the display may momentarily become abnormal screen.
- (3) In case of Vcc = off level, please keep the level of input signals on the low or keep a high impedance.
- (4) t4 should be measured after the module has been fully discharged between power off and on period.
- (5) Interface signal shall not be kept at high impedance when the power is on.
- (6) CMO won't take any responsibility for the products which are damaged by the customers not following the Power Sequence.
- (7) There might be slight electronic noise when LCD is turned off (even backlight unit is also off). To avoid this symptom, we suggest "Vcc falling timing" to follow "t7 spec".



## 7. OPTICAL CHARACTERISTICS

### 7.1 TEST CONDITIONS

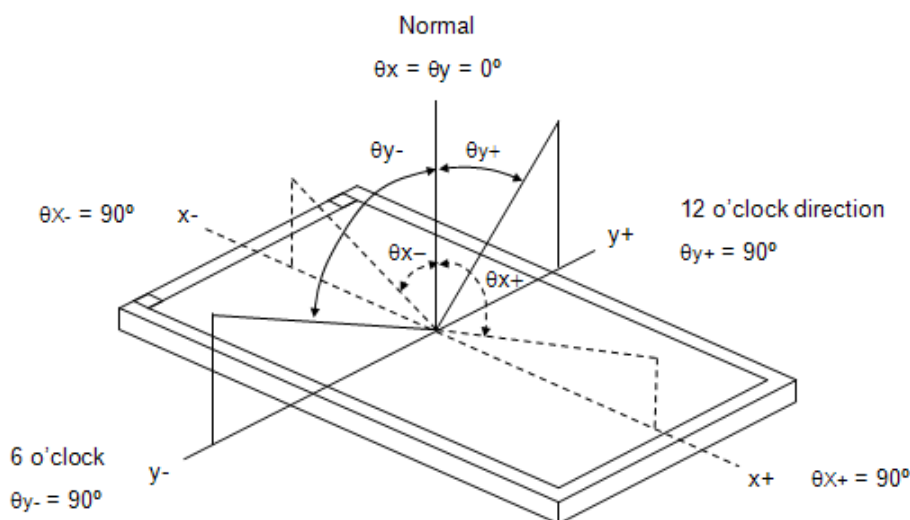
| Item                                      | Symbol                                                        | Value    | Unit             |
|-------------------------------------------|---------------------------------------------------------------|----------|------------------|
| Ambient Temperature                       | Ta                                                            | 25±2     | °C               |
| Ambient Humidity                          | Ha                                                            | 50±10    | %RH              |
| Supply Voltage                            | V <sub>CC</sub>                                               | 5        | V                |
| Input Signal                              | According to typical value in "3. ELECTRICAL CHARACTERISTICS" |          |                  |
| LED Light Bar Input Current Per Input Pin | I <sub>PIN</sub>                                              | 40 ± 0.6 | mA <sub>DC</sub> |
| PWM Duty Ratio                            | D                                                             | 100      | %                |
| LED Light Bar Test Converter              | CMO 27-D041745                                                |          |                  |

### 7.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 7.2. The following items should be measured under the test conditions described in 7.1 and stable environment shown in Note (5).

| Item                          |            | Symbol                                       | Condition                                        | Min.       | Typ.           | Max.       | Unit     | Note     |
|-------------------------------|------------|----------------------------------------------|--------------------------------------------------|------------|----------------|------------|----------|----------|
| Color Chromaticity (CIE 1931) | Red        | R <sub>x</sub>                               | $\theta_x=0^\circ, \theta_Y=0^\circ$<br>CS-2000T | Typ – 0.03 | 0.644          | Typ + 0.03 | ---      | (1), (5) |
|                               |            | R <sub>y</sub>                               |                                                  |            | 0.338          |            |          |          |
|                               | Green      | G <sub>x</sub>                               |                                                  |            | 0.310          |            |          |          |
|                               |            | G <sub>y</sub>                               |                                                  |            | 0.619          |            |          |          |
|                               | Blue       | B <sub>x</sub>                               |                                                  |            | 0.153          |            |          |          |
|                               |            | B <sub>y</sub>                               |                                                  |            | 0.062          |            |          |          |
|                               | White      | W <sub>x</sub>                               |                                                  |            | 0.313          |            |          |          |
|                               |            | W <sub>y</sub>                               |                                                  |            | 0.329          |            |          |          |
|                               |            | Center Luminance of White (Center of Screen) |                                                  |            | L <sub>C</sub> |            |          |          |
| Contrast Ratio                |            | CR                                           | 700                                              | 1000       | ---            | ---        | (2), (6) |          |
| Response Time                 |            | T <sub>R</sub>                               | $\theta_x=0^\circ, \theta_Y=0^\circ$             | ---        | 1.3            | 2.2        | ms       | (3)      |
|                               |            | T <sub>F</sub>                               |                                                  | ---        | 3.7            | 5.8        | ms       |          |
| White Variation               |            | δW                                           | $\theta_x=0^\circ, \theta_Y=0^\circ$<br>USB2000  | ---        | ----           | 1.42       | -        | (5), (6) |
| Viewing Angle                 | Horizontal | $\theta_{x+} + \theta_{x-}$                  | CR ≥ 10<br>USB2000                               | 150        | 170            | ---        | Deg.     | (1), (5) |
|                               |            |                                              |                                                  |            |                | ---        |          |          |
|                               | Vertical   | $\theta_{Y++} \theta_{Y-}$                   |                                                  | 140        | 160            | ---        |          |          |
|                               |            |                                              |                                                  |            |                | ---        |          |          |
| Viewing Angle                 | Horizontal | $\theta_{x+} + \theta_{x-}$                  | CR ≥ 5<br>USB2000                                | 160        | 178            | ---        | Deg.     | (1), (5) |
|                               |            |                                              |                                                  |            |                | ---        |          |          |
|                               | Vertical   | $\theta_{Y++} \theta_{Y-}$                   |                                                  | 150        | 170            | ---        |          |          |
|                               |            |                                              |                                                  |            |                | ---        |          |          |

Note (1) Definition of Viewing Angle ( $\theta_x$ ,  $\theta_y$ ):



Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{255} / L_0$$

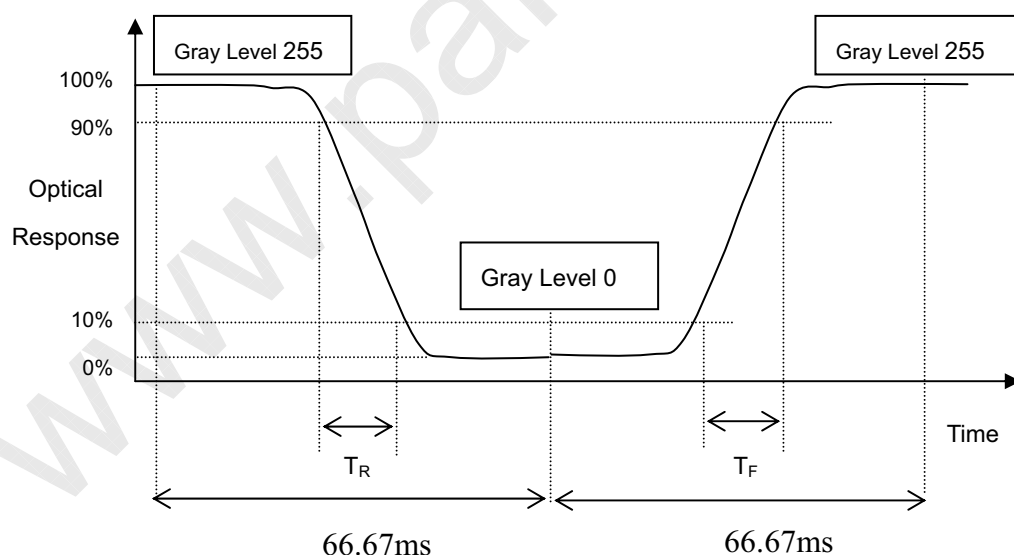
L255: Luminance of gray level 255

L 0: Luminance of gray level 0

$$CR = CR(5)$$

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (6).

Note (3) Definition of Response Time ( $T_R$ ,  $T_F$ ):



Note (4) Definition of Luminance of White ( $L_C$ ):

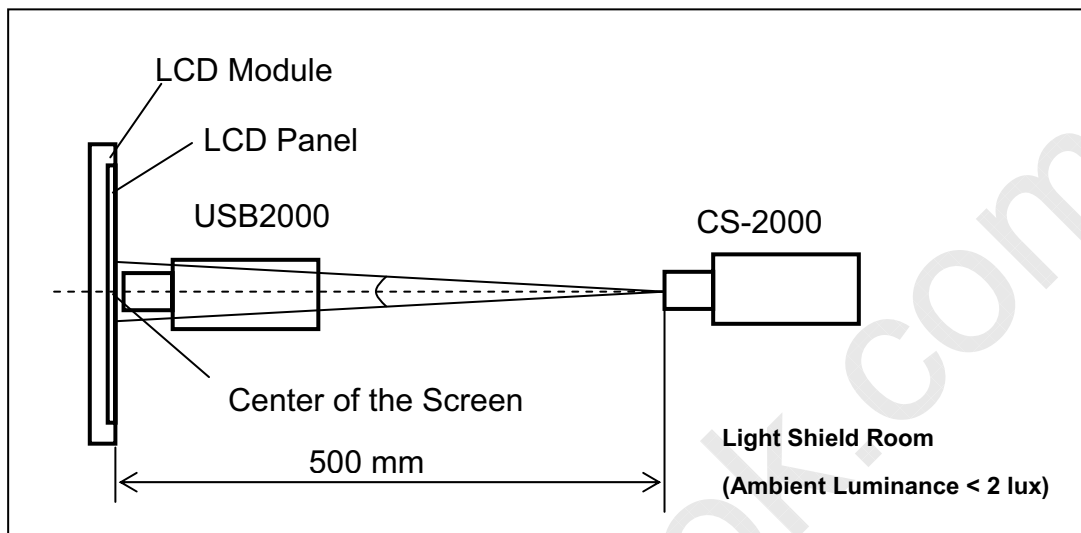
Measure the luminance of gray level 255 at center point

$$L_C = L(5)$$

L (x) is corresponding to the luminance of the point X at Figure in Note (6).

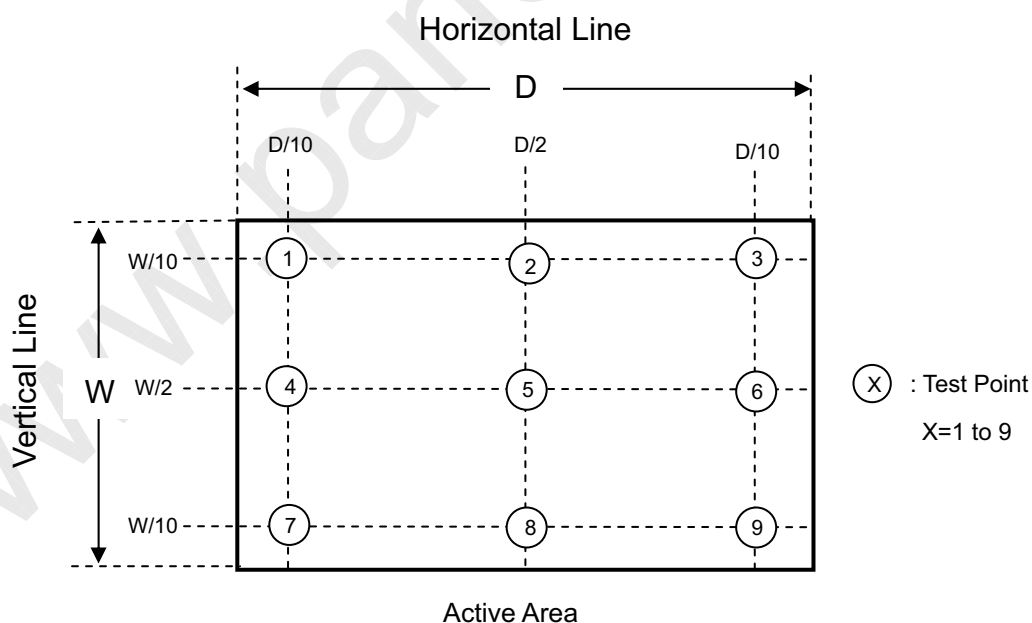
**Note (5) Measurement Setup:**

The LCD module should be stabilized at given temperature for (30 minutes) to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for (30 minutes) in a windless room.

**Note (6) Definition of White Variation ( $\delta W$ ):**

Measure the luminance of gray level 255 at 9 points

$$\delta W = \text{Maximum [L (1) ~ L (9)]} / \text{Minimum [L (1) ~ L (9)]}$$



## 8. PACKAGING

### 8.1 PACKING SPECIFICATIONS

- (1) 12 LCD modules / 1 Box
- (2) Box dimensions: 563(L) X 390 (W) X 375 (H) mm
- (3) Weight: 26.81Kg (12 modules per box)

### 8.2 PACKING METHOD

- (1) Carton Packing should have no failure in the following reliability test items.

| Test Item     | Test Conditions                                                                                                                                                    | Note          |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Vibration     | ISTA STANDARD<br>Random, Frequency Range: 1 – 200 Hz<br>Top & Bottom: 30 minutes (+Z), 10 min (-Z),<br>Right & Left: 10 minutes (X)<br>Back & Forth 10 minutes (Y) | Non Operation |
| Dropping Test | 1 Conner, 3 Edge, 6 Face, 45.7cm (ISTA Standard)                                                                                                                   | Non Operation |

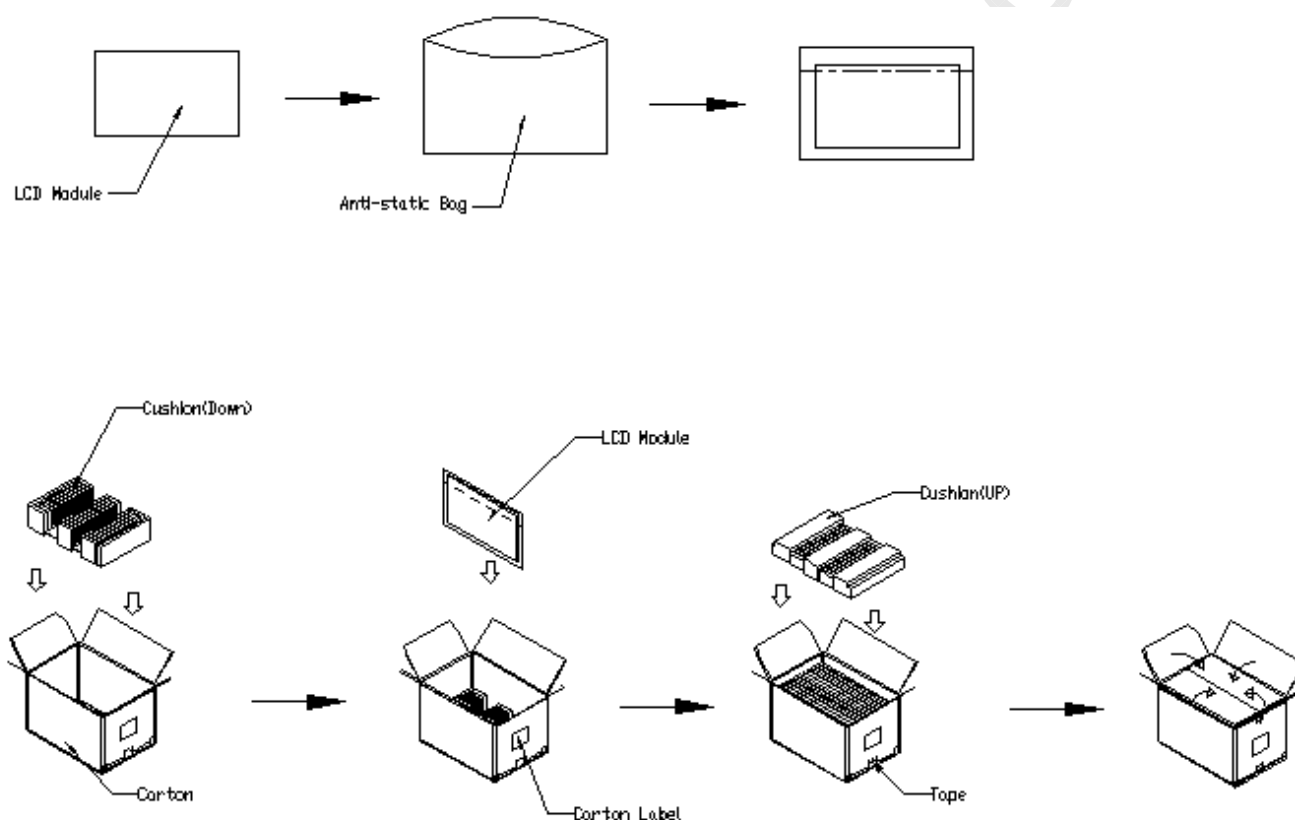
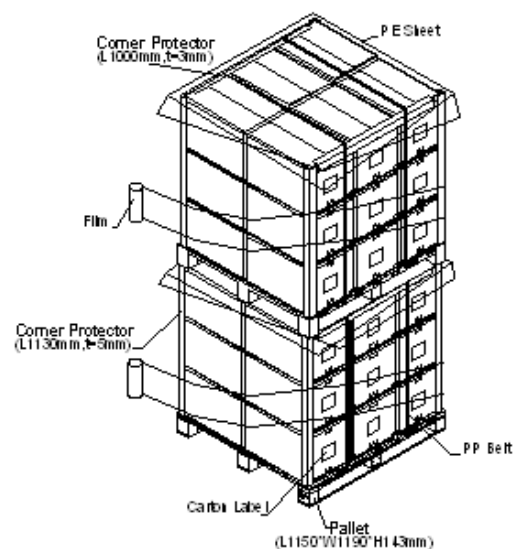


Figure. 8-1 Packing method

For ocean shipping

Sea / Land Transportation  
(40ft HQ Container)



Sea / Land Transportation  
(40ft Container)

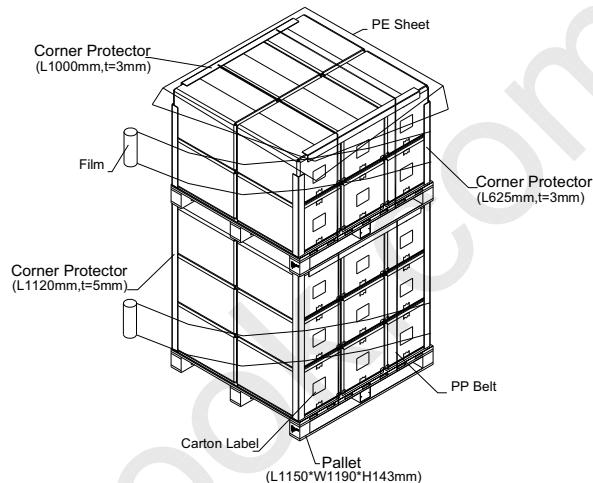


Figure. 8-2 Packing method

For air transport

Air Transportation

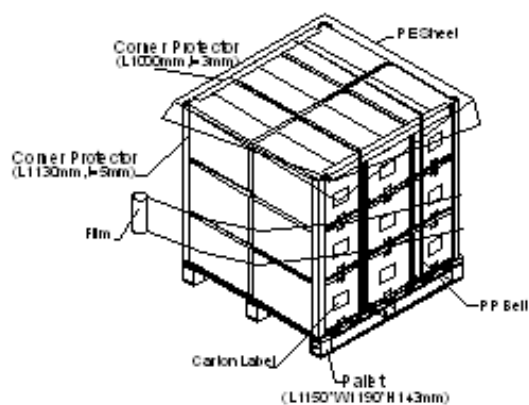


Figure. 8-3 Packing method

## 9. DEFINITION OF LABELS

### 9.1 CMO MODULE LABEL

The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.



(a) Model Name: M215H3-LA1

(b) Revision: Rev. XX, for example: A0, A1... B1, B2... or C1, C2...etc.

(c) CMO barcode definition:

Serial ID: XX-XX-X-XX-YMD-L-NNNN

| Code | Meaning          | Description                                                                                                                                                               |
|------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| XX   | CMO internal use | -                                                                                                                                                                         |
| XX   | Revision         | Cover all the change                                                                                                                                                      |
| X    | CMO internal use | -                                                                                                                                                                         |
| XX   | CMO internal use | -                                                                                                                                                                         |
| YMD  | Year, month, day | Year: 0~9, 2001=1, 2002=2, 2003=3...2010=0, 2011=1, 2012=2...<br>Month: 1~12=1, 2, 3, ~, 9, A, B, C<br>Day: 1~31=1, 2, 3, ~, 9, A, B, C, ~, W, X, Y, exclude I, O, and U. |
| L    | Product line #   | Line 1=1, Line 2=2, Line 3=3, ...                                                                                                                                         |
| NNNN | Serial number    | Manufacturing sequence of product                                                                                                                                         |

(d) Customer's barcode definition:

Serial ID: CM-L53A1-X-X-X-XX-L-XX-L-YMD-NNNN

| Code  | Meaning               | Description                                                                                                                                                                                                       |
|-------|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CM    | Supplier code         | CMO=CM                                                                                                                                                                                                            |
| L5H31 | Model number          | M215H3-LA1=L53A1                                                                                                                                                                                                  |
| X     | Revision code         | ZBD, C1=A, C2=B, ....<br>Non ZBD, C1=1, C2=2, ....                                                                                                                                                                |
| X     | Source driver IC code | Century=1, CLL=2, Demos=3, Epson=4, Fujitsu=5, Himax=6, Hitachi=7, Hynix=8, LDI=9, Matsushita=A, NEC=B, Novatec=C, OKI=D, Philips=E, Renasas=F, Samsung=G, Sanyo=H, Sharp=I, TI=J, Topro=K, Toshiba=L, Windbond=M |
| X     | Gate driver IC code   |                                                                                                                                                                                                                   |
| XX    | Cell location         | Tainan, Taiwan=TN                                                                                                                                                                                                 |
| L     | Cell line #           | 1~Z                                                                                                                                                                                                               |
| XX    | Module location       | Tainan, Taiwan=TN ; NB, China=NP ; NH, China=NH                                                                                                                                                                   |
| L     | Module line #         | 1~Z                                                                                                                                                                                                               |
| YMD   | Year, month, day      | Year: 0~9, 2001=1, 2002=2, 2003=3...2010=0, 2011=1, 2012=2...<br>Month: 1~12=1, 2, 3, ~, 9, A, B, C<br>Day: 1~31=1, 2, 3, ~, 9, A, B, C, ~, T, U, V                                                               |
| NNNN  | Serial number         | Manufacturing sequence of product                                                                                                                                                                                 |

(e) UL Factory ID:

| Region | Factory ID |
|--------|------------|
| TWCMO  | GEMN       |
| NBCMO  | LEOO       |
| NBCME  | CANO       |
| NHCMO  | CAPG       |





## 10. Reliability Test

Environment test conditions are listed as following table.

| Items                             | Required Condition                                                                                                | Note |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------|------|
| Temperature Humidity Bias (THB)   | Ta= 50℃ , 80%RH, 240hours                                                                                         |      |
| High Temperature Operation (HTO)  | Ta= 50℃ , 50%RH , 240hours                                                                                        |      |
| Low Temperature Operation (LTO)   | Ta= 0℃ , 240hours                                                                                                 |      |
| High Temperature Storage (HTS)    | Ta= 60℃ , 240hours                                                                                                |      |
| Low Temperature Storage (LTS)     | Ta= -20℃ , 240hours                                                                                               |      |
| Vibration Test<br>(Non-operation) | Acceleration: 1.5 Grms<br>Wave: Half-sine<br>Frequency: 10 - 300 Hz<br>Sweep: 30 Minutes each Axis (X, Y, Z)      |      |
| Shock Test<br>(Non-operation)     | Acceleration: 50 G<br>Wave: Half-sine<br>Active Time: 11 ms<br>Direction : ± X, ± Y, ± Z.(one time for each Axis) |      |
| Thermal Shock Test (TST)          | -20℃/30min , 60℃ / 30min , 100 cycles                                                                             |      |
| On/Off Test                       | 25℃ ,On/10sec , Off /10sec , 30,000 cycles                                                                        |      |
| ESD (Electro Static Discharge)    | Contact Discharge: ± 8KV, 150pF(330Ω)                                                                             |      |
|                                   | Air Discharge: ± 15KV, 150pF(330Ω)                                                                                |      |
| Altitude Test                     | Operation:10,000 ft / 24hours<br>Non-Operation:30,000 ft / 24hours                                                |      |

## 11. PRECAUTIONS

### 11.1 ASSEMBLY AND HANDLING PRECAUTIONS

- (1) Do not apply rough force such as bending or twisting to the module during assembly.
- (2) To assemble or install module into user's system can be only in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- (3) It's not permitted to have pressure or impulse on the module because the LCD panel and Backlight will be damaged.
- (4) Always follow the correct power sequence when LCD module is connecting and operating. This can prevent damage to the CMOS LSI chips during latch-up.
- (5) Do not pull the I/F connector in or out while the module is operating.
- (6) Do not disassemble the module.
- (7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
- (8) It is dangerous that moisture come into or contacted the LCD module, because moisture may damage LCD module when it is operating.
- (9) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.
- (10) When ambient temperature is lower than 10°C may reduce the display quality. For example, the response time will become slowly.

### 11.2 SAFETY PRECAUTIONS

- (1) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
- (2) After the module's end of life, it is not harmful in case of normal operation and storage.

### 11.3 SAFETY STANDARDS

The LCD module should be certified with safety regulations as follows:

- (1) UL60950-1 or updated standard.
- (2) IEC60950-1 or updated standard.

### 11.4. Storage

- (1) Do not leave the module in high temperature, and high humidity for a long time.  
It is highly recommended to store the module with temperature from 0°C to 35°C  
And relative humidity of less than 70%
- (2) Do not store the TFT – LCD module in direct sunlight
- (3) The module should be stored in dark place. It is prohibited to apply sunlight or fluorescent light in storing

### 11.5. Operation condition guide

- (1) The LCD product should be operated under normal condition.

Normal condition is defined as below :

Temperature :  $20\pm 15^{\circ}\text{C}$

Humidity:  $65\pm 20\%$

Display pattern : continually changing pattern(Not stationary)

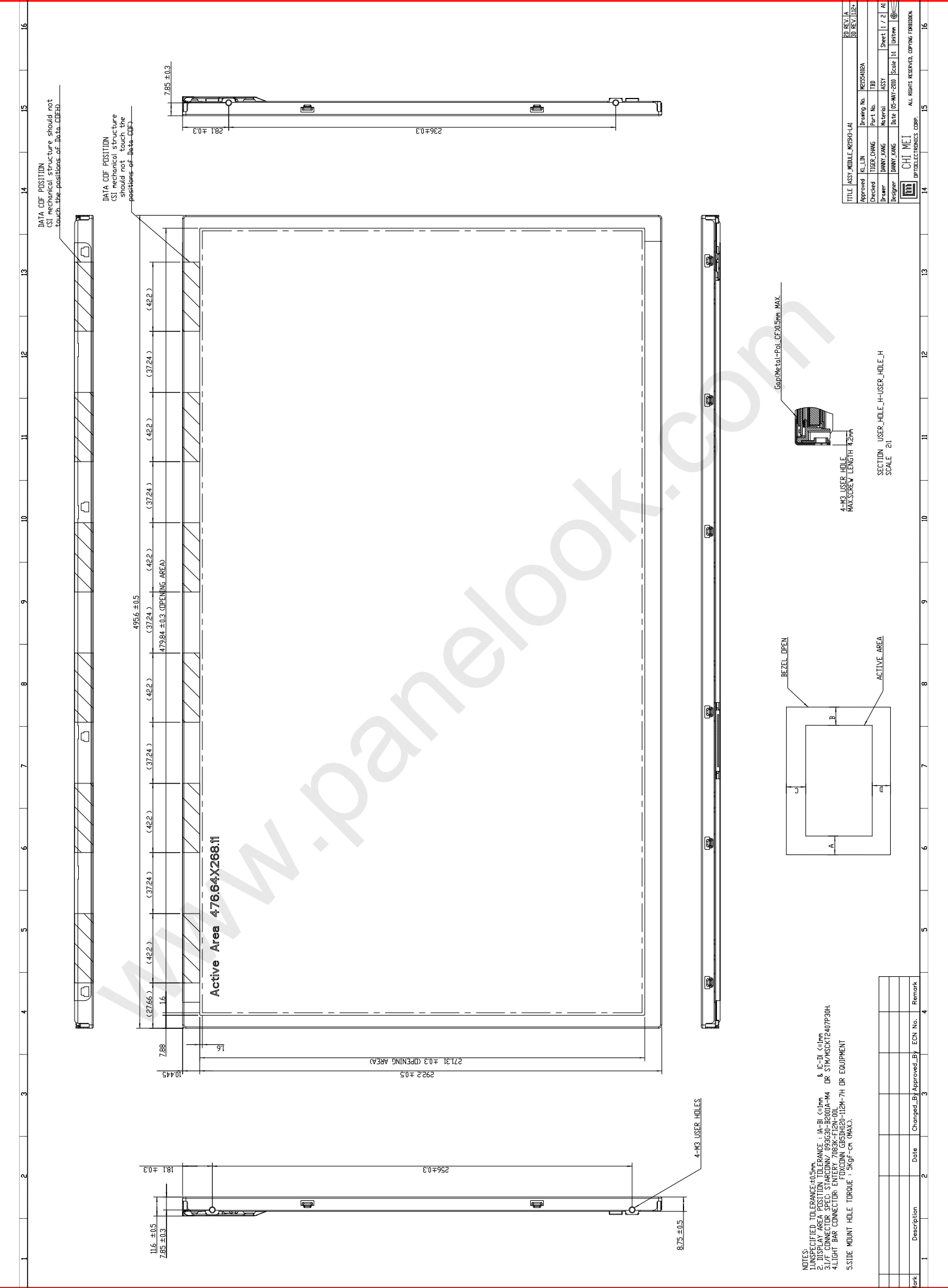
- (2) If the product will be used in extreme conditions such as high temperature , high humidity , high altitude , display pattern or operation time etc...It is strongly recommended to contact CMO for application engineering advice . Otherwise , Its reliability and function may not be guaranteed.

### 11.6 OTHER

When fixed patterns are displayed for a long time, remnant image is likely to occur.

## 12. MECHANICAL CHARACTERISTICS

[Refer to the next 2 pages]



|    |  |  |    |    |
|----|--|--|----|----|
| 14 |  |  |    | 16 |
| 14 |  |  | 15 | 16 |

|   |   |   |   |
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